Recent U.S. and China's Trade Issues

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1. Introduction

From 2004 to 2008, China's share of the U.S. tire market surged from 4.7% to 16.7%. Furthermore, between January and July of 2009, U.S. imported $1.3 billion worth of tires from China. The U.S. tire producers claim that this unprecedented increase in imports of tires from China hurt their industry.

Consequently, the United States imposed tariffs on Chinese tires for a three-year period (35% in the first year, 30% in the second year, and 25% in the third year), in addition to the existing 4% import duty.

In 2010, China retaliated by imposing anti-dumping duties, ranging from 50.3% to 105.4%. These retaliatory tariffs adversely impacted the trade in tires and poultry between the two countries. U.S. imports of Chinese tires declined from $2851 million in 2008 to $2416 million in 2009, and Chinese imports of U.S. poultry also fell from $733.48 million in January 2010 to $210.27 million in November 2010.

2. Objectives

The objectives of this study are to

(1) analyze tariff retaliations using a game theoretical framework,

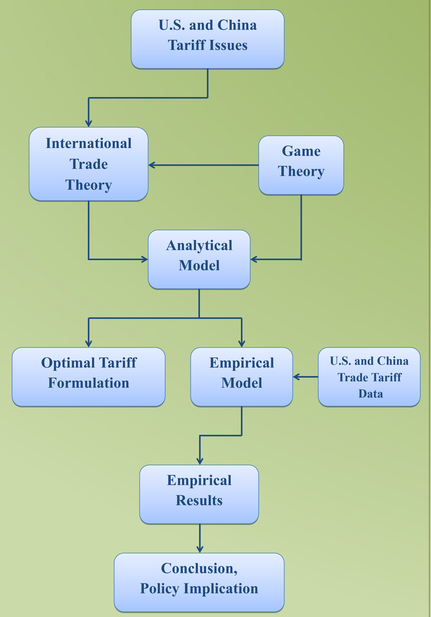
(2) determine the Nash equilibrium tariffs and compare them to the actual tariffs, and

(3) estimate the impacts of tariffs on U.S. tires imports and Chinese imports of poultry products.

3. Methods

The theoretical model consists of two countries (United States and China) and two commodities (tire and poultry products).

- The utility preference is given by Cobb-Douglas function with each country having different taste for both commodities.
- The production function of each good is quasiconcave, leading to the production possibility frontier which is concave to the origin. The technology, thus the shape of production possibility frontier, differs between the countries.
- Using the utility functions, production possibility frontiers, trade balances, tariff revenues, price linkages, and excess demand functions, the tariff reaction function is derived for each country. The reaction functions are solved simultaneously to determine the Nash Equilibrium tariffs.
- Comparative statics analysis show that home country tariff is monotonically decreasing in both foreign country tariff and foreign country GDP. We also provide sufficient conditions for the existence of Nash Equilibrium.



5. Theoretical Model and Results

Maximize utility subject to the constraints:

$$Max\ U^i\left(D_p^i, D_t^i\right) = \left(D_p^i\right)^{\alpha_i}\left(D_t^i\right)^{1-\alpha_i} \quad (Utility\ Function)$$

$$S.T\ \ D_p^i + p_i D_t^i = S_p^i + p_i S_t^i + \left(T_i - 1\right) pI_t^i \quad (Budget\ Costraint)$$

$$S_t^i = m_i - \left(S_p^i\right)^{n_i} \quad (Production\ Possibility\ Frontier)$$

$$p_i = pT_i \quad (Price\ Linkage)$$

$$pI_t^i = X_p^i = I_p^i \quad (Balance\ of\ Payments)$$

$$where\ i = U(United\ States), C\ (China).$$

The reaction functions are:

$$\begin{cases} t_U = \dfrac{(n_C - 1)}{n_C}\left\{\dfrac{\alpha_C m_C \left(1+t_C\right)^{\frac{n_C}{1-n_C}}}{\left(pn_C\right)^{\frac{n_C}{1-n_C}}\left[\alpha_C + n_C\left(1-\alpha_C\right)\right]} - 1\right\} \\ t_C = \left(1-n_U\right)\left\{\dfrac{n_U \alpha_U m_U}{\left[n_U p\left(1+t_U\right)\right]^{\frac{n_U}{1-n_U}}\left[\left(1-\alpha_U\right)n_U + \alpha_U\right] + \left(n_U - 1\right)\alpha_U m_U} - 1\right\} \end{cases}$$

Comparative Statics Results:

(1) U.S. tariff decreases monotonically with respect to Chinese tariff.

$$\frac{dt_U}{dt_C} = -\frac{\alpha_C m_C \left(1+t_C\right)^{\frac{2n_C-1}{1-n_C}}}{\left(pn_C\right)^{\frac{n_C}{1-n_C}}\left[\alpha_C + n_C\left(1-\alpha_C\right)\right]} < 0$$

(2) U.S. tariff decreases monotonically with respect to Chinese production capacity.

$$\frac{dt_U}{dm_C} = -\frac{\left(1-n_C\right)}{n_C}\frac{\alpha_C \left(1+t_C\right)^{\frac{n_C}{1-n_C}}}{\left(pn_C\right)^{\frac{n_C}{1-n_C}}\left[\alpha_C + n_C\left(1-\alpha_C\right)\right]} < 0$$

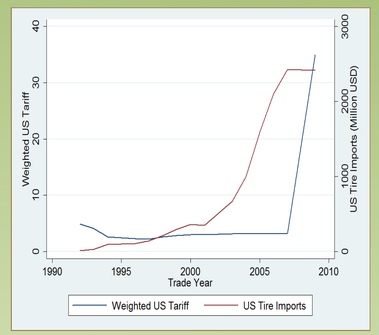
(3) U.S. tariff increases monotonically with respect to Chinese relative taste.

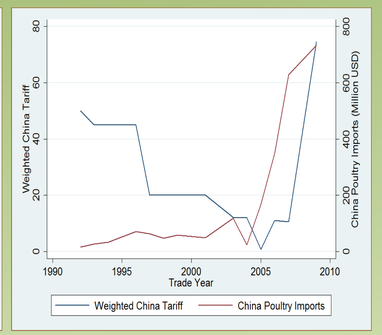
$$\frac{dt_U}{d\left(\dfrac{1-\alpha_C}{\alpha_C}\right)} = \frac{m_C\left(1-n_C\right)\left(1+t_C\right)^{\frac{n_C}{1-n_C}}}{\left(pn_C\right)^{\frac{n_C}{1-n_C}}\left[1 + n_C\dfrac{\left(1-\alpha_C\right)}{\alpha_C}\right]^2} > 0$$

6. Empirical Analysis

To empirically implement the theoretical analysis:

- U.S. excess demand for Chinese tires and China's excess demand for U.S. poultry are estimated.
- Explanatory variables are in the excess demand functions are own prices, complementary and substitute prices, demand shifters (e.g., income), supply shifters (e.g., input prices), and tariffs.
- U.S. tire tariff and Chinese poultry tariff equations are estimated.
- Because of the simultaneity problem, three stages least square method is used.





Data Source and Summary Statistics

The data for the empirical analysis comes from various sources:

- National Agricultural Statistics Service (NASS) for U.S. poultry domestic price
- Food and Agriculture Organization (FAO) for quantity and value of poultry trade data
- U.S. International Trade Commission (USITC) and World Bank data for U.S. tire import tariff and China poultry import tariff
- GDP data comes from International Financial Statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Trade year	15	2000	5.31	1992	2009
Weighted US Tariff Rate	15	5.22	8.26	2.22	35
US Tire Imports (Thousand Dollars)	15	787091.20	896561.50	12378.83	2425585.00
US GDP (Billion Dollars)	15	10962.30	1688.26	8287.10	13228.90
Weighted China Tariff Rate	15	27.07	20.12	0.70	74.50
China Poultry Imports (Thousand Dollars)	15				
China GDP (10 Billions of Dollars)	15	502.66	153.11	317.09	893.78
Poultry Price (Thousand Dollars/Unit)	15	0.06	0.05	0.01	0.18
D1	15	0.27	0.46	0	1
D2	15	0.67	0.49	0	1

Results

	Coefficient	Std. Error	z	P>z
US Tariff Equation				
China Tariff**	-0.11	0.04	-2.55	0.01
US Tire Imports	0.00	0.00	1.60	0.11
China GDP*	-0.02	0.01	-1.70	0.09
Poultry Price	0.26	6.20	0.04	0.97
Dummy 1***	-40.40	4.14	-9.76	0.00
Dummy 2***	-42.72	4.42	-9.67	0.00
Constant***	54.52	8.47	6.44	0.00
R-squared	0.99			
China Tariff Equation				
US Tariff	-2.39	3.20	-0.75	0.46
China Poultry Imports	0.00	0.00	0.70	0.48
US GDP**	0.00	0.00	-2.29	0.02
Poultry Price	-5.54	36.67	-0.15	0.88
Dummy 1	-118.62	98.87	-1.20	0.23
Dummy 2	-138.81	102.13	-1.36	0.17
Constant**	212.90	104.03	2.05	0.04
R-squared	0.97			

*** p<0.01, ** p<0.05, * p<0.1

- Since the goodness of fit statistics or R^2 values are very high (0.97 to 0.99), the estimate values accurately predict the actual data.
- The empirical results confirm the theoretical results in that the U.S. tariff decreases in China's tariff and Chinese GDP. One percent increase in China's tariff reduces U.S. tariff by 0.11 percent. One unit increase in China's GDP lowers U.S. tariff by 0.02 percent.
- Similarly, Chinese tariff also decreases in U.S. tariff and GDP. One percent increase in U.S. tariff reduces China's tariff by 2.39 percent and one unit increase in U.S. GDP lowers China's tariff by 0.005 percent. Using the estimated equations, we solve for equilibrium tariffs.

7. Conclusion

This paper uses a game theoretical framework to analyze retaliatory tariffs by the United States and China. The theoretical analysis ascertains the Nash equilibrium tariff levels. The empirical analysis quantifies Nash equilibrium tariffs and compares them to the actual tariffs imposed by these two countries. We also estimate the impacts of tariffs on U.S. tires imports and Chinese poultry imports.

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